Excitation functions of proton induced reactions on ^{nat}Sn: relevance to the production of ^{111}In and ^{114m}In for medical applications

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The ^{111}In is used both for diagnostic and therapeutic purposes. The 114mIn is a therapeutic radioisotope. The production possibility of the medically used ^{111}In and ^{114m}In were investigated via proton irradiation of tin targets by determining the excitation functions, production yields and the impurity levels. According to our knowledge no earlier results are available in this energy range in the literature. The aim of investigation of this route was to avoid difficulties with commonly used, expensive, highly enriched targets (^{111}Cd, ^{112}Cd, ^{113}Cd, ^{114}Cd). The excitation functions for production of ^{111mg,114m,117m}In radioisotopes were measured from 30 up to 70 MeV by using activation method, stacked foil irradiation technique and direct HpGe gamma counting of irradiated samples. The irradiations were done at an external beam line of Tohoku University cyclotron. The beam intensity and the energy degradation were controlled in the whole energy range by simultaneously measured ^{nat}Al(p,x)^{22,24}Na and ^{nat}Cu(p,x)^{56,58}Co, ^{62,65}Zn monitor reactions. Theoretical excitation functions for ^{nat}Cd(p,x)^{111,114,117}In reactions have been calculated using the well developed Alice-IPPE code. The measured experimental results were compared with the yields obtained earlier for other high energy alternative production routes (by using Cd and In targets with natural isotopic composition or by using highly enriched Cd targets).

According to our results to production of high purity ^{111}In for diagnostic purposes is possible only through the decay of ^{111}Sn via chemical separation of the directly produced indium radioisotopes after EOB. For therapy only a mixture of ^{111}In and ^{114m}In radioisotopes can be produced effectively by proton induced nuclear reactions on natural tin target.

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